SUMMARY AND CONCLUSIONS.

Three factors appeared to be very suitable for the research into the way in which the number and the arrangement of the places of exit in pollen-grains is brought about; they are: 1°. the simple form usually to be reduced to two types only, which the pollen possessed when the places of exit were formed on the surface. 2°. the fact that pollen-grains are pre-eminently suitable for statistical ends. 3°. the occurrence of variations in number and arrangement of the places of exit.

The variation in number of places of exit was statistically traced and a typical correlation appeared to exist between the size of the pollen and the number of places of exit, in that sense that the diameter of a grain was about expressed by the following formula. Diam. $= (a \text{ to } a + 1) \times V$ when the number of places of exit lay in one plane or as meridian grooves and Diam. $= (\sqrt{a \text{ to } a + 1}) \times V$, when the places of exit are distributed over the whole surface, *Diam.* representing the diameter of the grain, a the observed

number of places of exit, and V a constant for pollen-grains of one species being under equal circumstances.

With polyploidy or abnormal reduction-division a great variation in the number of places of exit can often be observed; in these cases it appears that an increase or decrease in the number of chromosomes runs parallel with variations in the size of the grain and the number of places of exit. Yet a variation in the number of places of exit correlated with the size of the grain can also occur without there being any differences in the number of chromosomes or in genetic constitution, which can be observed in the differences in size which can be found in the pollen of heterostylic plants (among others *Lythrum Salicaria*).

To the arrangement of the places of exit in the pollen, however variable it may be, yet a general rule obtains: that equidistance is observed in which the distance from a place of exit to the nearest places of exit is nearly equal in value.

From the equidistance of the places of exit and from the fact that with the correlation between the size of the pollen and the number of places of exit, a place of exit is not observed to appear before a certain space is cleared for it on the surface, we might infer that the arrangement and the number of places of exit only depends on the closest covering of the space occupied by the places of exit over the entire surface or that part of the grain that allows of formation of places of exit.

If this view is correct, the numbers observed and the arrangement of the places of exit of the pollen-grains will have to nearly correspond with the constructions of point-systems on the sphere drawn up on equal theoretical conditions. It appeared that such constructions not only correspond well with the numbers and arrangement observed in nature, but that moreover from such point-systems we

could more or less infer which numbers would be preferred in nature, and which not, which again tallied with the facts observed.

Therefore I think that I possess in the above some arguments pleading for the view that the number and the arrangement of the places of exit and consequently the symmetry of the pollen-grains arises from the closest possible arrangement of a number of areas on that part of the surface where this formation is possible.

In my opinion, therefore, the symmetry of the pollen is not previously extant in the protoplasm, but arises only consequent on the junction of as great as possible a number of equivalent parts.